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Ikuta

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(54) **POWER TOOL**

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B25F 5/00 (2006.01)
B25D 17/24 (2006.01)

(52) **U.S. Cl.**
CPC ***B25D 17/24*** (2013.01); *B25D 2211/068* (2013.01); *B25D 2217/0088* (2013.01); *B25D 2217/0092* (2013.01)

(58) **Field of Classification Search**
CPC B25D 17/24; B25D 2217/0076; B25D 2217/0088; B25D 2217/0092; B25D 2211/068; F16F 7/1005
See application file for complete search history.

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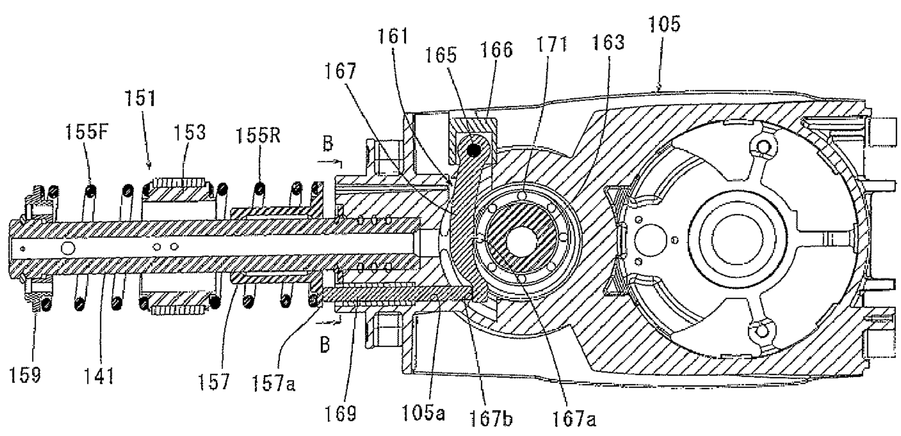
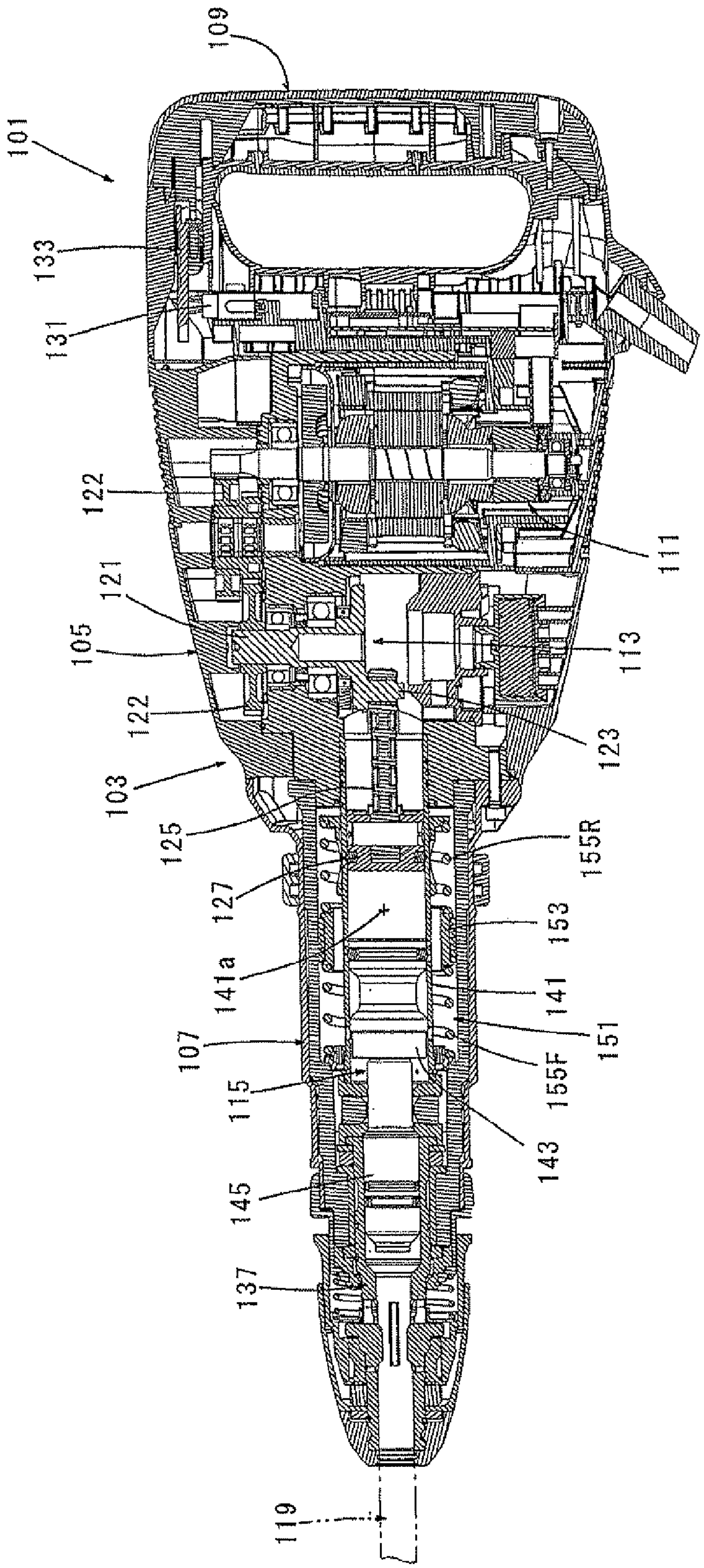
(57) **ABSTRACT**

A power tool, which actuates a tool linearly in a longitudinal direction of the tool, the power tool performs a predetermined operation to a workpiece, having: a drive mechanism which actuates the tool; a rotational shaft which actuates the drive mechanism; a swing lever which swings along the longitudinal direction by a rotational motion of the rotational shaft; and a dynamic vibration reducer which alleviates vibration generated during the predetermined operation. The dynamic vibration reducer includes a weight which is linearly movable in the longitudinal direction an elastic member which biases the weight. The weight is adapted to be actuated mechanically and forcibly by a motion component with respect to the longitudinal direction of a swinging motion of the swing lever in a state that the weight is biased by the elastic member.

8 Claims, 5 Drawing Sheets

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101
133
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122
111
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155R
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141a
141
107
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155F
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143
145
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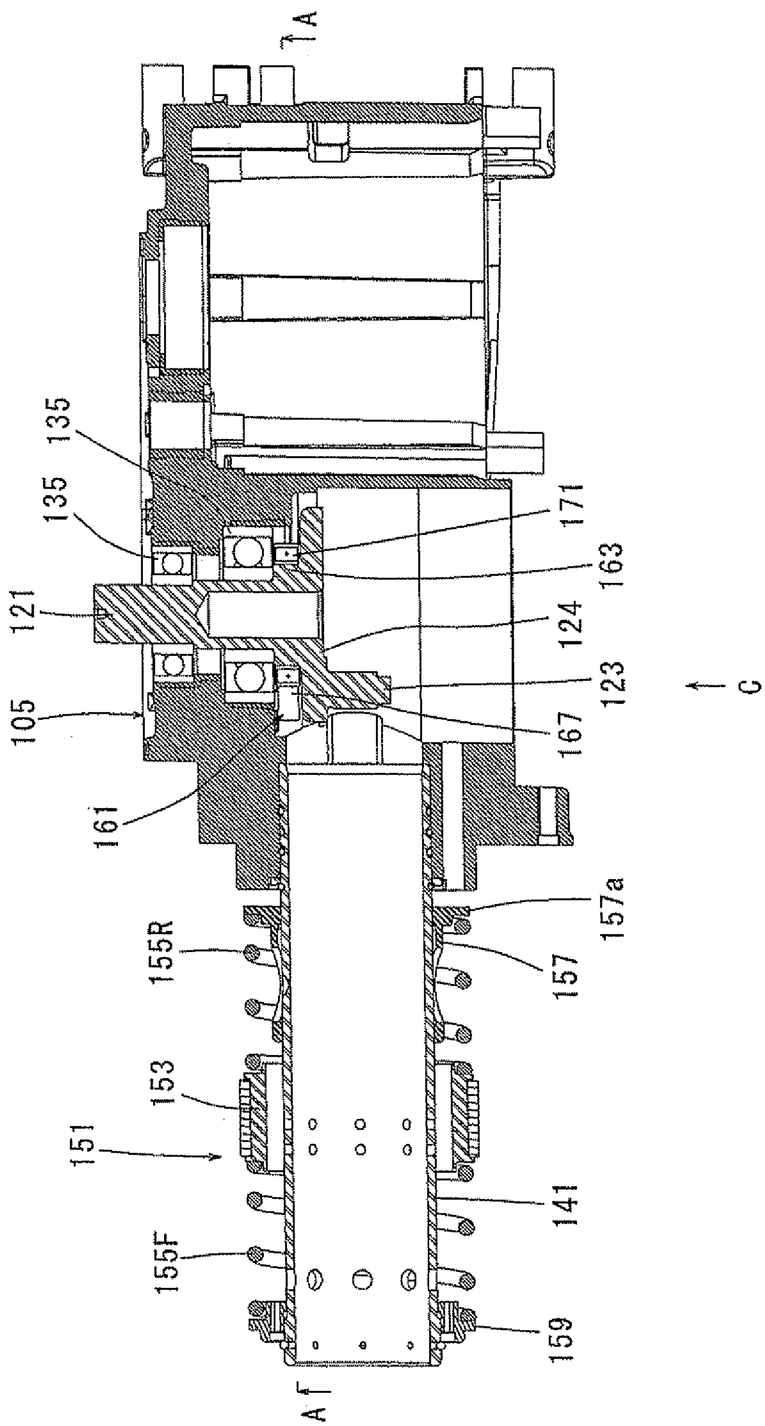
119

FIG. 1


A
135
135
121
105
161
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124
123
167
C
157a
155R
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141
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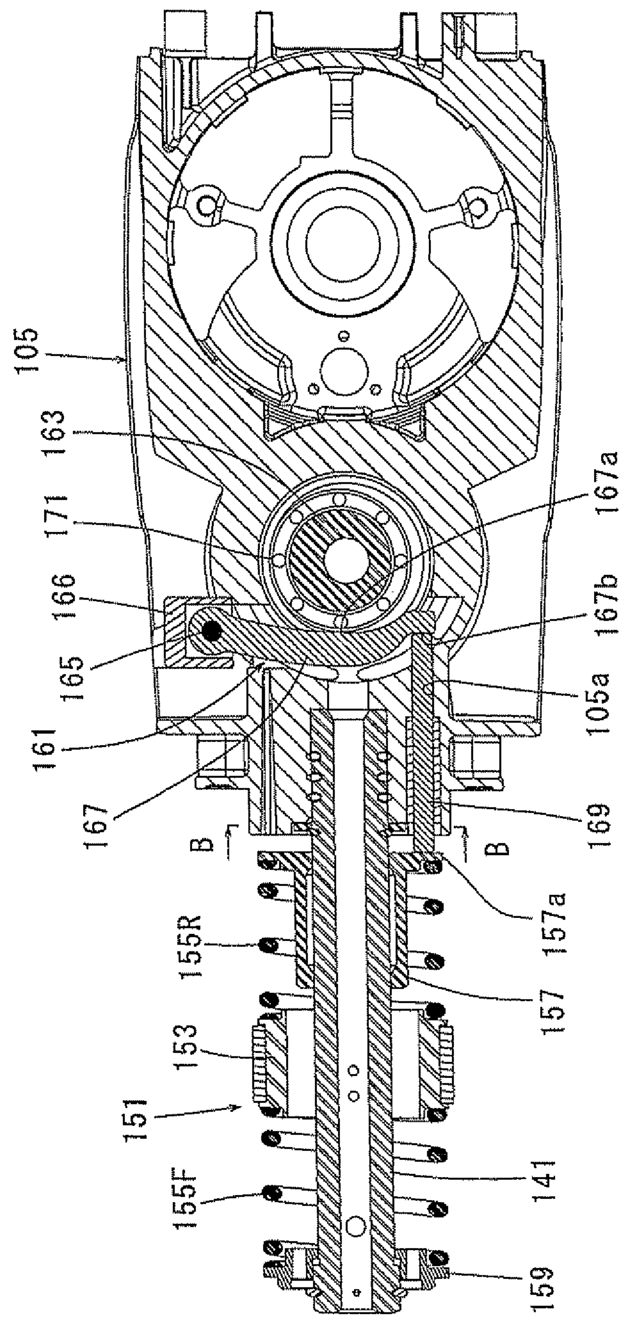
A

FIG. 2



105
163
171
166
165
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167
B
155R
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151
155F
167a
167b
105a
169
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141
159

FIG. 3

FIG. 4

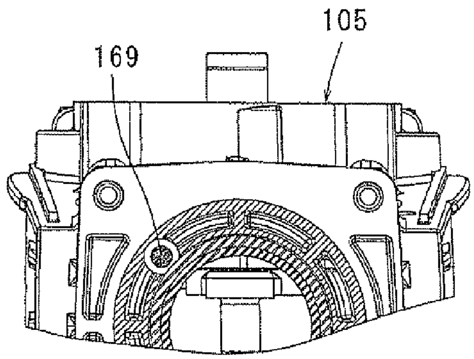


FIG. 5

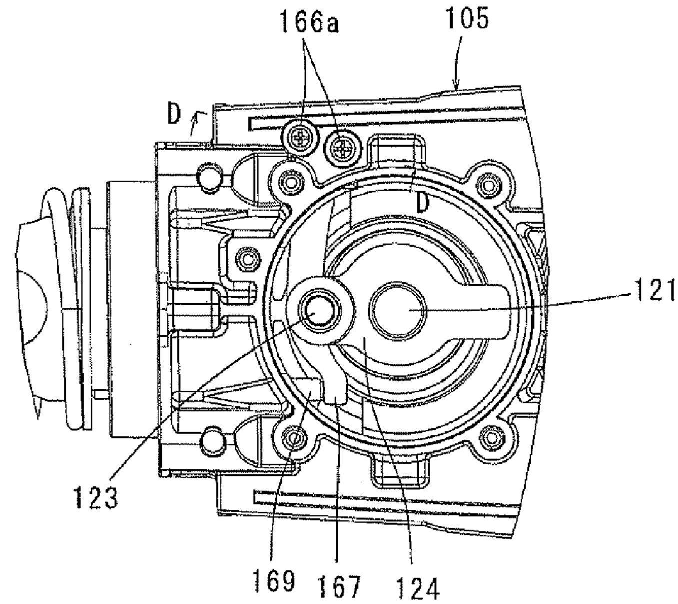


FIG. 6

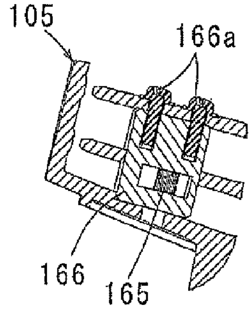


FIG. 7

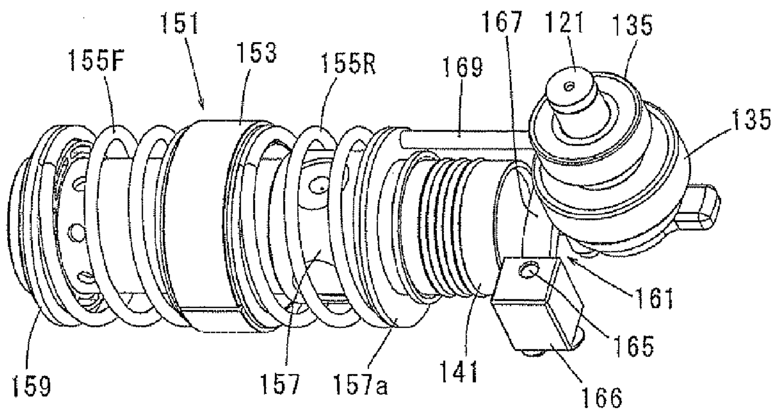


FIG. 8

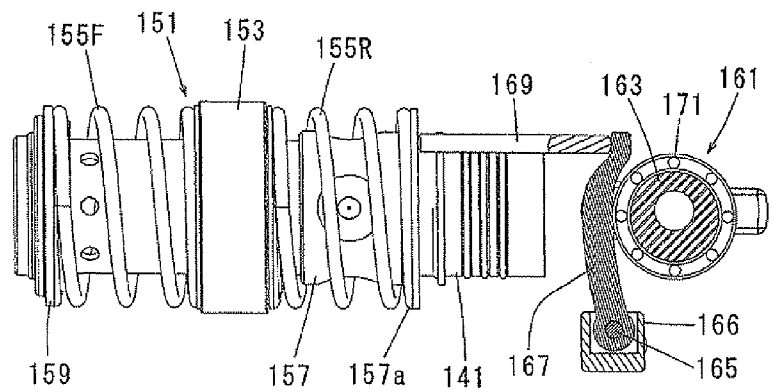
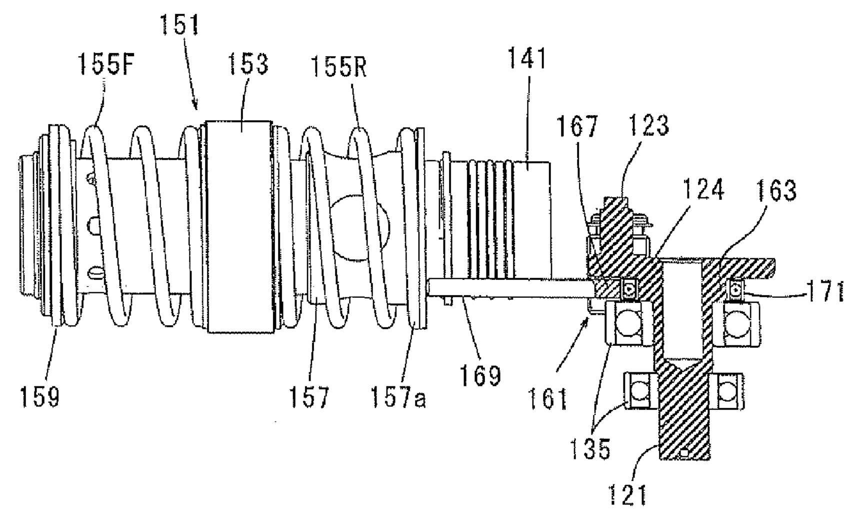


FIG. 9



POWER TOOL

CROSS REFERENCE TO RELATED APPLICATION

The present application claims priority from Japanese Patent Application No. 2011-123303, filed on Jun. 1, 2011, the disclosure of which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

The invention relates to a power tool which actuates a tool linearly in a longitudinal direction of the tool and performs a predetermined operation to a workpiece.

BACKGROUND OF THE INVENTION

Japanese non-examined Patent Application Publication No. 2008-307655 discloses a power tool having a dynamic vibration reducer as vibration suppression device which alleviates vibration generated when the power tool is working. The power tool described in No. 2008-307655, has a crank mechanism which is actuated by a motor and actuates a hammering mechanism. In addition a second crank mechanism is disposed at one side of the crank mechanism opposed to the motor. The second crank mechanism actuates a weight of the dynamic vibration reducer aggressively. Namely vibration generated during an operation is decreased by forcibly actuating the dynamic vibration reducer.

However, because the crank mechanism for hammering the tool bit and the second crank mechanism for actuating the dynamic vibration reducer are disposed to be aligned with each other in an axial direction, a construction of the power tool is complicated and irrational for the purpose of weight saving of the power tool.

SUMMARY OF THE INVENTION

Problem to be Solved by the Invention

An object of the invention is, in consideration of the above described problem, to provide a power tool to improve a technique with respect to a forcible actuation of a dynamic vibration reducer.

Means for Solving the Problem

Above-mentioned object is achieved by the claimed invention. According to a preferable aspect of the invention, a power tool which actuates a tool linearly in a longitudinal direction of the tool which performs a predetermined operation to a workpiece is provided. The power tool comprising: a drive mechanism which actuates the tool; a rotational shaft which actuates the drive mechanism; a swing member which swings along the longitudinal direction by a rotational motion of the rotational shaft; and a dynamic vibration reducer which alleviates vibration generated when the tool is performing the predetermined operation. The dynamic vibration reducer includes a weight which is linearly movable in the longitudinal direction and an elastic member which biases the weight. Further the weight is adapted to be actuated mechanically and forcibly by a motion component with respect to the longitudinal direction of a swinging motion of the swing member in a state that the weight is biased by the elastic member.

A terminology of "mechanically" in the invention is defined by a feature that the dynamic vibration reducer and

the swing member is connected to each other thereby a power is transmitted between the dynamic vibration reducer and the swing member. In a state that the weight is biased by a biasing force of the elastic element, the weight is actuated and alleviates vibration passively on the basis of vibration generated during the predetermined operation. A terminology of "forcibly" in the invention is defined by a feature that the dynamic vibration reducer alleviates vibration actively to be exerted vibration force as an external force which is different from vibration generated during the predetermined operation. A predetermined operation of the invention preferably includes features that a tool performs a hammering operation to make a hammering motion with respect to a longitudinal direction of the tool to a workpiece, a tool performs a hammer drill operation to make a hammering motion with respect to a longitudinal direction of the tool and a rotational motion with respect to a circumference direction of the tool to a workpiece, and a blade performs a cutting operation to make a linear motion with respect to a longitudinal direction of the blade to a workpiece.

According to the aspect, the weight of the dynamic vibration reducer is driven by the swing member which is swung by the rotational shaft for driving the tool. In this way a composition of driving the weight is simplified and lightened. Namely, driving the weight is reasonably improved. Since the composition of driving the weight is simplified, a total cost of the power tool is decreased.

According to a further preferable aspect of the invention, the power tool further comprises a rotational member which integrally rotates together with the rotational shaft. The swing member is adapted to be swung by a motion component with respect to a radial direction of a rotational motion of the rotational member. It is preferred that the rotational member is arranged within the range of a required length of the rotational shaft which is designed in advance for driving the drive mechanism, without extending the length of the rotational shaft for the purpose of arranging the rotational member. The rotational member of the invention is generally provided with a circular disk whose center is positioned at a position radially offset from a center of a rotational motion of the rotational shaft, namely the rotational member is provided with an eccentric cam. According to this aspect, because the swing member is arranged within the range of the length of the rotational shaft, the power tool is downsized with respect to a longitudinal direction of the rotational shaft.

According to a further preferable aspect of the invention, the power tool further comprises a support shaft which supports the swing member as a support point of the swinging motion of the swing member. The support shaft is arranged to be parallel to the rotational shaft. According to this aspect, a rotational motion of the rotational shaft is reasonably changed to a swinging motion of the swing member.

According to a further preferable aspect of the invention, a center of the rotational member is arranged at an eccentric position which is offset from a center of a rotational motion of the rotational shaft. A displacement of the weight by means of the motion component with respect to the longitudinal direction of the swinging motion of the swing member is defined by a displacement of the swing member and an offset distance of the rotational member. According to this aspect, the displacement of the weight is defined by adjusting the displacement of the swing member and/or the offset distance of the rotational member.

According to a further preferable aspect of the invention, the swing member includes and actuated part which is actuated by the rotational member and an actuating part which actuates the weight. A length between the support point and the actuated part is shorter than a length between the support point and the actuating part. According to this aspect, the displacement of the actuating part which actuates the weight is amplified by the displacement of the actuated part. Therefore the displacement of the swing member which drives the weight is obtained easily.

According to a further preferable aspect of the invention, the power tool further comprises a bearing which supports an intermediate part of the rotational shaft in a longitudinal direction of the rotational shaft being rotatable. The rotational shaft includes a tool actuating part which actuates the tool at one end of the rotational shaft in the longitudinal direction of the rotational shaft. The rotational member is arranged between the intermediate part and the tool actuating part in the longitudinal direction of the rotational shaft. According to this aspect, because the rotational member is arranged on the rotational shaft, a size with respect to the longitudinal direction of the rotational shaft is downsized.

According to a further preferable aspect of the invention, the power tool further comprises a rolling bearing which is arranged and intervened between the rotational member and the swing member. According to this aspect, a burning and/or a friction of contacting surfaces of the rotational member and swing member is reduced.

According to a further preferable aspect of the invention, the rotational member is provided with an eccentric cam which is arranged integrally with the rotational shaft.

According to the invention, a power tool which is effectively improved with respect to a forcible actuation of a dynamic vibration reducer is provided.

Other objects, features and advantages of the invention will be readily understood after reading the following detailed description together with the accompanying drawings and the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a cross-sectional view of a total composition of an electrical hammer in accordance with an embodiment of the invention.

FIG. **2** shows a cross-sectional view of a dynamic vibration reducer and a surrounding area of the dynamic vibration reducer in which a motor and a gear and so on are not shown.

FIG. **3** shows a cross-sectional view taken from line A-A of FIG. **2**.

FIG. **4** shows a cross-sectional view taken from line B-B of FIG. **3**.

FIG. **5** shows a bottom view of FIG. **2**.

FIG. **6** shows a cross sectional view taken from line D-D of FIG. **5**.

FIG. **7** shows a perspective view of a forcible vibration exerting mechanism of the dynamic vibration reducer.

FIG. **8** shows a partial cross-sectional view of the forcible vibration exerting mechanism of the dynamic vibration reducer.

FIG. **9** shows a 90 degrees rotated partial cross-sectional view of the forcible vibration exerting mechanism of FIG. **8**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Each of the additional features and method steps disclosed above and below may be utilized separately or in conjunction with other features and method steps to provide and manufacture improved power tools and method for using such the power tools and devices utilized therein. Representative examples of the invention, which examples utilized many of these additional features and method steps in conjunction, will now be described in detail with reference to the drawings. This detailed description is merely intended to teach a person skilled in the art further details for practicing preferred aspects of the present teachings and is not intended to limit the scope of the invention. Only the claims define the scope of the claimed invention. Therefore, combinations of features and steps disclosed within the following detailed description may not be necessary to practice the invention in the broadest sense, and are instead taught merely to particularly describe some representative examples of the invention, which detailed description will now be given with reference to the accompanying drawings.

An embodiment of the invention will be explained with reference to FIG. **1** to FIG. **9**. In this embodiment, the invention will be explained by applying to an electrical hammer as one example of a power tool. As shown in FIG. **1**, the electrical hammer **101** is mainly provided with a body **103**, a tool holder **137**, a hammer bit **119** and a hand grip **109**. The body **103** is defined as a power tool body which constitutes an outline of the electrical hammer **101**. The tool holder **137** is disposed at a front part (a left side part of FIG. **1**) of the body **103** in a longitudinal direction of the body **103**. The hammer bit **119** is adapted to detachably connect to the tool bit **137**. The hand grip **109** is defined as a main handle held by a user, which is disposed at an opposed part (a right side part of FIG. **1**) with respect to the hammer bit **119** in the longitudinal direction of the body **103**. The hammer bit **119** corresponds to a tool of the invention. The hammer bit **119** is held by the tool holder **137** so that the hammer bit **119** is reciprocally relatively movable against the tool holder **137** with respect to the longitudinal direction of the body **103** and is regulated to relatively rotate against the tool holder **137** with respect to a circumference direction of the tool holder **137**. Hereinafter, a side where the hammer bit **119** is disposed is called a front side of the electrical hammer **101** and the other side where the hand grip **109** is disposed is called a rear side of the electrical hammer **101**.

The body **103** is mainly provided with a main housing **105** and a barrel housing **107**. The main housing **105** houses a driving motor **111** and a motion conversion mechanism **113**. The barrel housing **107** is formed as an approximately cylindrical shape and housed a hammering element **115**. The driving motor **111** is disposed to which a rotational axis extends in a vertical direction of FIG. **1** and crosses the longitudinal direction of the body **103**. Namely, the rotational axis of the driving motor **111** crosses the longitudinal direction of the body **103**. A rotational output of the driving motor **111** is converted to a linear motion by the motion conversion mechanism **113** and is transmitted to the hammering element **115** and thereby an impact force to the hammer bit **119** via the hammering element **115** in a longitudinal direction of the hammer bit **119** is generated. The motion conversion mechanism **113** and the hammering element **115** correspond to a drive mechanism of the invention. The barrel housing **107** is disposed at a front end of the main housing **105** and extends in the longitudinal direction of the hammer bit **119**.

The hand grip **109** is disposed to extend and cross the longitudinal direction of the hammer bit **119** and has connecting portions. The connecting portions which protrude toward the front side of the electrical hammer **101** are disposed at an upper end and a lower end of the hand grip **109**. The hand grip **109** is connected to the body at the upper part and the lower part, therefore the hand grip **109** is shown a substantially D-shape in a side view. A switch **131** and an operated member **133** are disposed at an upper part of the hand grip **109**. The switch **131** is movable between an ON-position and an OFFposition when a user slides the operated member **133**. The driving motor **111** is driven by a movement of the switch **131**.

The motion converting mechanism **113** converts a rotational motion of the driving motor **111** to a linear motion and transmits the linear motion to the hammering element **115**. The motion converting mechanism **113** is mainly provided with a crank mechanism which comprises a crank shaft **121**, an eccentric pin **123**, a connecting rod **125** and a piston **127** and so on. The crank shaft **121** is driven by the driving motor **111** via a plurality of gears and thereby the crank shaft **121** is decelerated. The eccentric pin **123** is disposed at an eccentric position which is positioned away from a rotational center of the crank shaft **121**. The connecting rod **125** is connected to the crank shaft **121** via the eccentric pin **123**. The piston **127** is linearly driven by the connecting rod **125**. The piston **127** is disposed slidably in a cylinder **141** thereby the piston **127** is moved linearly along the cylinder **144** in association with a driving of the driving motor **111**. The crank shaft **121** corresponds to a rotational shaft of the invention.

The hammering element **115** is mainly provided with a striker **143** and an impact bolt **145**. The striker **143** is defined as an impacting member and is disposed in the cylinder **141** thereby the striker **143** is slidable in contact with an inner surface of the cylinder **141**. The impact bolt **145** is defined as an intermediate member which transmits a motion energy of the striker **143** to the hammer bit **119** and is disposed to be slidable against the tool holder **137**. An air room **141***a* is formed between the piston **127** and the striker **143** inside the cylinder **141**. The striker **143** is driven via an air spring of the air room **141***a* in association with a sliding movement of the piston **127** and impinges on the impact bolt **145** which is slidably disposed against the tool holder **137**. Therefore an impact power is transmitted to the hammer bit **119** via the impact bolt **145**.

As to the electrical hammer **101** descried above, when the driving motor **111** is driven, the piston **127** is slid linearly along the cylinder **141** via the motion conversion mechanism **113** which is mainly composed of the crank mechanism. When the piston **127** is slid, the striker **143** is moved toward the front side in the cylinder **141** by means of an effect of the air spring of the air room **141***a* of the cylinder **141**. Then the striker **143** impinges on the impact bolt **145** thereby the motion energy is transmitted to the hammer bit **119**. When a user exerts a pressing force toward the front side on the body **103** and the hammer bit **119** is pressed against a workpiece, the hammer bit **119** operates a hammering operation on the workpiece such as concrete.

A dynamic vibration reducer **151** which alleviates vibration on the body **103** when the electrical hammer **101** is working, and a mechanical forcible vibration exerting mechanism **161** which exerts a movement mechanically and forcibly on the dynamic vibration reducer **151** will be explained. Hereinafter, to exert the movement forcibly on the dynamic vibration reducer **151** is called a forcible vibration exertion. As shown in FIG. **2**, FIG. **7** to FIG. **9**, the dynamic vibration reducer **151** is mainly provided with a weight **153** and springs **155**F, **155**R. The weight **153** is disposed so as to circularly surround an outside surface of the cylinder **141**. The springs **155**F, **155**R are respectively disposed at a front side and a rear side of the weight **153** with respect to the longitudinal direction of the hammer bit **119**. The dynamic vibration reducer **151** is disposed at an inner space of the barrel housing **107** of the body **103** (refer to FIG. **1**). The springs **155**F, **155**R respectively exert an elastic force on the weight **153** from the front side and the rear side of the weight **153** when the weight **153** is moved in the longitudinal direction of the hammer bit **119**. The springs **155**F, **155**R correspond to an elastic member of the invention.

A gravity point of the weight **153** is disposed so as to be aligned with a longitudinal axis of the hammer bit **119**. An outside surface of the weight **153** is slidably disposed along the barrel housing **107** in a state that the outside surface of the weight **153** is in contact with an inner surface of the barrel housing **107**. Namely the inner surface of the barrel housing **107** is defined as a guide surface which guides a linear motion of the weight **153**. Similar to the weight **153**, respective gravity points of the springs **155**F, **155**R are disposed respectively so as to be aligned with the longitudinal axis of the hammer bit **119**. One end (rear end) of a spring **155**R is adapted to contact with a front surface of a flange **157***a* of the slide sleeve **157** represented as a sliding member, and the other end (front end) of the spring **155**R is adapted to contact with a rear end of the weight **153** with respect to the longitudinal direction. One end (rear end) of a spring **155**F is adapted to contact with a front end of the weight **153**, and the other end (front end) of the spring **155**F is adapted to contact with a ring-shaped spring receiving member **159** which is disposed at a front side of the cylinder **141** and is fixed on the outside surface of the cylinder **141**.

The slide sleeve **157** is defined as an inputting member which inputs a driving force of the forcible vibration exerting mechanism **161** to the weight **153** via the spring **155**R. The slide sleeve **157** is slidably engaged with the outside surface of the cylinder **141** with respect to the longitudinal direction of the hammer bit **119** and is slid by the forcible vibration exerting mechanism **161**.

As shown in FIG. **3**, the forcible vibration exerting mechanism **161** is mainly provided with an eccentric cam **163**, a support shaft **165**, a swing lever **167** and a power transmission pin **169**. The eccentric cam **163** is disposed on the crank shaft **121** thereby the eccentric cam **163** is integrally rotated together with the crank shaft **121**. The swing lever **167** is driven by a rotational motion of the eccentric cam **163** and is swung along a front-back direction around the support shaft **165** as a swinging support point. The power transmission pin **169** transmits a motion component with respect to the longitudinal direction of the hammer bit **119** of a swinging motion of the swing lever **167** to the weight **153**.

As shown in FIG. **2**, the crank shaft **121** extends in a vertical direction crossing the longitudinal direction of the hammer bit **119**. One of a plurality of gears **122** (refer to FIG. **1**) which transmits the rotational output of the driving motor **111** to the crank shaft **121** is fixed at one side in an axis direction of the crank shaft **121**. A crank plate **124** which communicates the eccentric pin **123** and the crank shaft **121** is arranged at the other side in the axis direction of the crank shaft **121**. The crank shaft **121** is rotatably supported by the main housing **105** via two ball bearings **135** arranged between the one side and the other side of the crank shaft **121**. A part between the one side and the other side in the axis direction of the crank shaft **121** corresponds to an intermediate part of the invention. The crank plate **124** and the eccentric pin **123** correspond to a tool actuating part of the invention.

As shown in FIG. **3**, the eccentric cam **163** is formed as a disk member whose center is positioned at an eccentric position which is offset from a rotational center of the crank shaft **121**. As shown in FIG. **2**, the eccentric cam **163** is disposed between the crank plate **124** and one of the ball bearings **135** integral with the crank shaft **121**. A rolling bearing **171** is engaged with a periphery of the eccentric cam **163**.

As shown in FIG. **3**, the swing lever **167** is disposed at a front of the crank shaft **121** so as to extend in a lateral direction crossing both a longitudinal direction of the crank shaft **121** and the longitudinal direction of the hammer bit **119**. One end of the swing lever **167** is swingably supported by the support shaft **165**. A front surface of a distal end of the swing lever **167** contacts with the power transmission pin **169**. And a rear surface of an intermediate part between the one end and the distal end of the swing lever **167** contacts with a periphery of the rolling bearing **171**. The swing lever **167** corresponds to a swing member of the invention. The distal end of the swing lever **167** which contacts with the power transmission pin **169** corresponds to an actuating part of the invention. The intermediate part of the swing lever **167** which contacts with the rolling bearing **171** corresponds to an actuated part of the invention.

The support shaft **165** is supported by bearing **166**. The swing lever **167** and the bearing **166** are assembled in advance via the support shaft **165**. As shown in FIG. **5** and FIG. **6**, the assembly of the swing lever **167** and the bearing **166** is arranged and fixed on the main housing **108** by fixing the bearing **166** by means of a fixing means such as a screw **166***a* and so on.

As shown in FIG. **3**, the power transmission pin **169** is slidably inserted into a pin inserted hole **105***a* which is arranged at the main housing **105** so as to extend linearly in the longitudinal direction of the hammer bit **119**. One end (rear end) with respect to a longitudinal direction of the power transmission pin **169** is adapted to contact with a front surface of the distal end of the swing lever **167**, and the other end (front end) with respect to the longitudinal direction of the power transmission pin **169** is adapted to contact with a rear surface of a flange **157***a* of the slide sleeve **157**. The end part of the power transmission pin **169** is formed sphery.

A behavior of the electrical hammer **101** described above will be explained as below. During a hammering operation by using the electrical hammer **101**, an impactive and frequent vibration with respect to the hammer bit **119** is generated on the body **103**. The dynamic vibration reducer **151** in this embodiment passively alleviates vibration on the body **103** by the weight **153** and the springs **155**F, **155**R work coactive. Therefore vibration generated on the body **103** of the electric hammer **101** is reduced effectively. During the hammering operation, for example a user operates the hammering operation by pressing the electrical hammer **101** against the workpiece. Under such circumstances, because a large load is exerted on the hammer bit **119**, vibration which is input into the dynamic vibration reducer **151** is regulated.

As to an operating state described above, vibration of the body **103** is effectively reduced by the forcible vibration exertion of the dynamic vibration reducer **151**. Namely when the crank shaft **121** is rotated, the eccentric cam **163** is integrally rotated together with the crank shaft **121**. Then the swing lever **167** is swung in the front-rear direction by the eccentric cam **163**. When the swing lever **167** is swung forward, the slide sleeve **157** is pressed and moved forward via the power transmission pin **169** thereby the springs **155**F, **155**R are compressed. When the swing lever **167** is swung rearward, the slide sleeve **157** is moved rearward by a biasing force of the springs **155**F, **155**R.

In this way, during the hammering operation the weight **153** of the dynamic vibration reducer **151** is driven actively via the springs **155**F, **155**R by the forcibly vibration exerting mechanism **161**. Accordingly the dynamic vibration reducer **151** is represented as vibration alleviation mechanism which actively drives the weight **153**. As a result, vibration with respect to the longitudinal direction of the hammer bit **119** generated during the hammering operation on the body **103** is effectively reduced.

According to this embodiment, the slide sleeve **157** is driven by the forcible vibration exerting mechanism **161** thereby the weight **153** is actively driven via the spring **155**R. Therefore adjusting a driven timing of the weight **153** by the forcible vibration exerting mechanism **161** to reduce the impactive vibration generated on the body **103** when the hammer bit **119** is hit via the striker **143** and the impact bolt **145**, vibration alleviation effect by the weight **153** is accomplished based on a preferable configuration.

Further, according to this embodiment, the forcible vibration exerting mechanism **161** is adapted to have the eccentric cam on the crank shaft **121** for hitting the hammer bit **119** thereby the weight **153** of the dynamic vibration reducer **151** is adapted to be driven by the eccentric cam **163** via the swing lever **167** and the power transmission pin **169**. Namely the forcible vibration exerting mechanism **161** is adapted and integrated with the crank mechanism for the hammering operation. Compared to the known composition which a crank mechanism for a hammering operation and a crank mechanism for a forcible vibration exerting mechanism are aligned in each other in their longitudinal direction, the forcible vibration exerting mechanism **161** is simplified and lightened. Therefore a total cost of the electrical hammer **101** is reduced. Further, because the forcible vibration exerting mechanism **161** is disposed within a range of a length of the crank shaft **121**, compared to the known composition, a size with respect to a longitudinal direction of the crank shaft is downsized.

Further, according to this embodiment, because the support shaft **165** which constitutes a support point of a swinging motion of the swing lever **167** is arranged to extend in parallel with the rotational axis of the eccentric cam **163**, the rotational motion of the eccentric cam **163** is reasonably changed into the swinging motion of the swing lever **167**.

Further, according to this embodiment, a displacement of the weight **153** is defined by adjusting a displacement of the swing lever **167** and/or an offset distance of the eccentric cam **163**.

Further, according to this embodiment, as shown in FIG. **3**, the intermediate part with respect to an extending direction of the swing lever **167** is contacted with the rolling bearing **171**. Therefore a distance between a center of the support shaft **165** and a contact part **167***b* which contacts with the power transmission pin **169** is longer than a distance between the center of the support shaft **165** and a contact part **167***a* which contacts with the eccentric cam **163**. Accordingly the weight **153** of the dynamic vibration reducer **151** is driven with an amplified displacement which is amplified from the eccentric distance of the eccentric cam **163**.

Further, according to this embodiment, because the rolling bearing **171** is disposed at the periphery of the eccentric cam **163**, a burning and/or a friction of contacting surfaces of the swing lever **167** and the rolling bearing **171** is reduced.

The electrical hammer **101** was explained as a one example of the power tool in this embodiment, however it is not limited to the electrical hammer **101**. For example, the invention may be applied to a hammer drill comprising the hammer bit **119** which actuates a hammering motion and a rotational motion. In addition, the invention may be applied to a jigsaw or a reciprocal saw which operate a cutting operation by moving a blade linearly against a workpiece.

DESCRIPTION OF NUMERALS

101 electrical hammer
103 body
105 main housing

107 barrel housing
109 hand grip
111 driving motor
113 motion conversion mechanism
115 hammering element
119 hammer bit
121 crank shaft
122 gear
123 eccentric pin
125 connecting rod
127 piston
131 switch
133 operated member
135 ball bearing
137 tool holder
141 cylinder
143 striker
145 impact bolt
151 dynamic vibration reducer
153 weight
155F spring
155R spring
157 slide sleeve
157*a* flange
159 spring receiving member
161 forcible vibration exerting mechanism
163 eccentric cam
165 support shaft
166 bearing
166*a* screw
167 swing lever
167*a* contact part
167*b* contact part
169 power transmission pin
171 rolling bearing

What is claimed is:

1. A power tool, which actuates a tool linearly in a longitudinal direction of the tool, the power tool performs a predetermined operation to a workpiece, comprising:

a drive mechanism which actuates the tool;

a rotational shaft which actuates the drive mechanism;

a rotational member which integrally rotates together with the rotational shaft;

a swing member which swings along the longitudinal direction by a rotational motion of the rotational shaft, wherein the swing member is adapted to be swung by a motion component with respect to a radial direction of a rotational motion of the rotational member;

a support shaft which supports the swing member as a support point of a swinging motion of the swing member, wherein the support shaft is arranged to be parallel to the rotational shaft and the support shaft is disposed such that its position change is prevented; and

a dynamic vibration reducer which alleviates vibration generated when the power tool is performing the predetermined operation,

wherein the dynamic vibration reducer includes a weight which is linearly movable in the longitudinal direction and an elastic member which biases the weight, and

wherein the weight is adapted to be actuated mechanically and forcibly by a motion component with respect to the longitudinal direction of the swinging motion of the swing member in a state that the weight is biased by the elastic member.

2. The power tool according to claim **1**, wherein a center of the rotational member is arranged at an eccentric position which is offset from a center of the rotational motion of the rotational shaft,

and wherein a displacement of the weight by means of the motion component with respect to the longitudinal direction of the swinging motion of the swing member is defined by a displacement of the swing member and an offset distance of the rotational member.

3. The power tool according to claim **2**, wherein the swing member includes an actuated part which is actuated by the rotational member and an actuating part which actuates the weight,

and wherein a length between the support point and the actuated part is shorter than a length between the support point and the actuating part.

4. The power tool according to claim **1**, further comprising a bearing which supports an intermediate part of the rotational shaft in a longitudinal direction of the rotational shaft being rotatable,

wherein the rotational shaft includes a tool actuating part which actuates the tool at one end of the rotational shaft in the longitudinal direction of the tool,

and wherein the rotational member is arranged between the intermediate part and the tool actuating part in the longitudinal direction of the rotational shaft.

5. The power tool according to claim **4**, further comprising a rolling bearing which is arranged and intervened between the rotational member and the swing member.

6. The power tool according to claim **1**, wherein the rotational member is provided with an eccentric cam which is arranged integrally with the rotational shaft.

7. A power tool, which actuates a tool linearly in a longitudinal direction of the tool, the power tool performs a predetermined operation to a workpiece, comprising:

a drive mechanism which actuates the tool;

a rotational shaft which actuates the drive mechanism, wherein the rotational shaft includes a tool actuating part which actuates the tool at one end of the rotational shaft in the longitudinal direction of the tool;

a rotational member which integrally rotates together with the rotational shaft;

a bearing which supports an intermediate part of the rotational shaft in a longitudinal direction of the rotational shaft being rotatable, wherein the rotational member is arranged between the intermediate part and the tool actuating part in the longitudinal direction of the rotational shaft;

a swing member which swings along the longitudinal direction by a rotational motion of the rotational shaft, wherein the swing member is adapted to be swung by a motion component with respect to a radial direction of a rotational motion of the rotational member; and

a dynamic vibration reducer which alleviates vibration generated when the power tool is performing the predetermined operation,

wherein the dynamic vibration reducer includes a weight which is linearly movable in the longitudinal direction and an elastic member which biases the weight,

wherein the weight is adapted to be actuated mechanically and forcibly by a motion component with respect to the longitudinal direction of a swinging motion of the swing member in a state that the weight is biased by the elastic member.

8. The power tool according to claim **7**, further comprising a rolling bearing which is arranged and intervened between the rotational member and the swing member.

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